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SPECIFICATION E-3390
QUESTIONS AND ANSWERS
REGARDING
THE PANEL DIAL SYSTEM
SAN FRANCISCO AND EAST BAY AREA

H. LUNDY

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SPECIFICATION E-3390
ISSUE NO.1
OCTOBER 1, 1927.

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY
NORTHERN CALIFORNIA AND NEVADA
ENGINEERING DEPARTMENT
SAN FRANCISCO

SPECIFICATION
OF
QUESTIONS AND ANSWERS
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FOR

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY
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— HARRY LUNDY —

HLUNDY

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SCOPE

THE INTRODUCTION OF PANEL DIAL EQUIPMENT WILL BRING ABOUT MANY CHANGES IN THE PROCEDURES AND PRACTICES NOW FOLLOWED UNDER MANUAL OPERATION. NEW TYPES OF APPARATUS AND CIRCUITS WILL BE PLACED IN SERVICE AND WHILE SPECIFICATIONS, CIRCULARS AND OTHER DATA HAVE BEEN ISSUED AND DISTRIBUTED TO THE DEPARTMENTS INTERESTED A NUMBER OF QUESTIONS REGARDING DIFFERENT EQUIPMENT FEATURES HAVE BEEN ASKED FROM TIME TO TIME AND ANSWERS HAVE BEEN GIVEN TO INDIVIDUAL QUESTIONS. IN ORDER TO MAKE THIS INFORMATION AVAILABLE TO A GREATER NUMBER OF THOSE INTERESTED IN THE PANEL SYSTEM THE QUESTIONS HAVE BEEN COLLECTED AND WITH THEIR ASSOCIATED ANSWERS HAVE BEEN COMPILED IN THIS SPECIFICATION.

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GENERAL

1. WHAT ARE THE PROPER NAMES FOR DIAL SYSTEMS?

The proper names for the dial systems now used by the associated companies of the Bell System are:

"Panel Dial System"

"Step-by-Step Dial System"

2. WHAT IS THE FIELD OF USE FOR THE TWO TYPES OF DIAL SYSTEM?

Panel equipment was designed by the Bell System especially to meet the service requirements of the large metropolitan areas. On the other hand step-by-step equipment has a clearly established field of use in single offices and the smaller multi-unit exchanges. In an area where one type is in predominance, it may not be found desirable or economical to change to another type. However the adoption of either type is a matter that can only be decided after an exhaustive study of the existing situation.

3. WHY IS THE "REVERSE IMPULSE CONTROL" METHOD USED FOR CONTROLLING PANEL TYPE SELECTORS?

The direct impulse control method involves the opening of the circuit at the sending end a definite number of times, causing a series of impulses, each of which drives the selector at the distant end one step forward. If this method were used the selector, which is a comparatively heavy mechanism, would be expected to follow the light mechanism at the sending end.

With the "reverse impulse control" method, the selection is performed by closing of the circuit at the sending end. This causes the distant selector to move upward, making connection with the contacts of its commutator. For each contact with the metal segment of the commutator, the selector sends an impulse to the sending mechanism. This continues until the proper number of impulses have been received by the sender when it opens the circuit and causes the selector to stop. Since the impulses that control the movement are sent by the selector toward the sending end, no steps can be lost due to the sending mechanism being light, while the selector is relatively heavy; if the selector is slow the sender will wait.

4. WHY ARE THREE DIGIT CODES USED FOR TOLL, INFORMATION ETC., IN TWO DIGIT CENTRAL OFFICE DISTRICTS?

Two digit codes could be used but in order to have these codes uniform in all cities having panel equipment it has been

decided to use three digits in two digit central office districts, the last digit performs no useful function in the two digit sender.

5. WHY IS 24-VOLT BATTERY USED FOR TALKING BATTERY FOR LOCAL CONNECTIONS IN PANEL SYSTEMS?

The talking circuits used in the panel dial system are the same as the talking circuits used in the manual system and any new developments which improve transmission can be used interchangeably in both the panel dial system and manual system. The present station equipment is also designed primarily for 24-volt talking battery supply.

In the case of the D.S."A" boards, 48-volt talking battery is furnished for the special service cord circuits. This is to supply a toll grade transmission in connection with A-B toll calls, etc.

6. WITH THE DIAL SYSTEM, WILL CONNECTIONS BE ESTABLISHED MORE QUICKLY THAN WITH MANUAL EQUIPMENT?

On connections from dial stations to other dial stations the connection will be established slightly quicker than with manual service. It should be noted that of the total time from the removal of the receiver until the called station answers, only a small part is affected with dial equipment and any changes in the total interval therefore, will be relatively slight. On connections between a dial station and a manual station the connection will be established in about the same time as required with manual service.

7. WILL ALL MANUAL P.B.X. STATIONS BE EQUIPPED WITH DIALS?

No. At P.B.X.'s the dialing will in general be done by the P.B.X. attendant just as the P.B.X. attendant now passes the call to the central office. However, if it is desired to have those using certain extensions dial their calls after having the attendant connect them to a central office trunk, these extensions may be equipped with dials, and they may then dial their calls instead of having the attendant do it for them. Also, if service is desired at certain extensions during hours when the board is not attended, these P.B.X. extensions are equipped with dials for dialing over night connections.

8. WHAT IS GAINED BY THE USE OF "POWER DRIVE"?

In connection with the design of the equipment the use of power drive permits the application of any amount of power needed without affecting the selecting speed and thus makes feasible the use of apparatus of comparatively heavy construction giving rigidity and stability. Firm, reliable contacts and larger

wearing margins are secured. Sufficient power may be applied to set the equipment rapidly in motion and it is driven with a smooth, even, continuous action without vibrations and incident heavy wear. High speeds may be given all moving parts, the speed being limited only by the accuracy required in stopping the brushes. These high speeds facilitate trunk hunting over large groups.

9. IS THERE NOT A PROBABILITY THAT THE LETTER "O" WILL BE CONFUSED WITH THE FIGURE "0"?

It is possible that this error might be made until the subscribers become familiar with the operation of the dial. To reduce the difficulties which might be experienced because of this, the dial number plate has black letters and red numerals. The sender circuits will also be so connected that the dialing of the numerical "0" (zero) as the second or third digit of an office name will have the same effect as dialing the letter "O".

LINE, STATION AND P.B.X. SWITCHBOARD

1. WHY ARE LETTERS OMITTED FROM THE "1" AND "0" HOLES ON THE DIAL? ?

The sender is so arranged that a preliminary pulse such as would be caused by accidentally operating the switchhook before starting to dial does not interfere with the circuit operation. As a preliminary pulse is equivalent to dialing "1" the digit "1" is never used as a pull for the office name. The digit "0" is reserved for readily securing the assistance of an operator. This leaves 8 holes for letters or a total of 24 letters. This makes it necessary to eliminate two letters from the alphabet and "Q" and "Z" have been omitted as being the least desirable for office names.

2. WHY ARE THERE NO 3 SLOT COIN BOX STATIONS IN THE GLEN-COURT PANEL UNIT?

As 3 slot coin box stations may be used by customers who are not familiar with dial operation it is considered advisable especially during the first period of dial operation and in mixed districts (manual and dial) to continue manual operation for all such stations. All pay stations will therefore be on a manual basis in districts having both dial and manual equipment, at least for the initial period.

In the case where an entire district is changed to dial operation such as Elmhurst-San Leandro, it is planned to operate the 3 slot coin station generally on a dial basis. It may be found desirable for the same reason as in mixed districts, to retain a limited number of stations on a semi-mechanical basis for a period following the cut-over.

3. WHAT IS MEANT BY HIGH SPEED DIALS AND WHERE ARE THEY USED?

The high speed dial with normal adjustment operates to transmit pulses at a rate of approximately 18 per second as compared with a normal speed of 9-1/2 pulses per second for other standard dials.

The principal advantage of the high speed dial is the increased operating efficiency that may be obtained due to the shorter interval required for dialing. It is intended primarily for improving the operating at private branch exchange positions of the large multiple type and on important non-multiple boards where there is a large volume of outgoing traffic. Under certain traffic operating conditions, it may also be employed to advantage at the D.S. "A" positions.

With the present standard arrangements, the high speed dial can only be used in conjunction with panel offices. It cannot be used for station installations and is also limited in use to certain trunk requirements in connection with P.B.X.'s.

4. CAN A CALL BE MADE FROM A DIAL COIN STATION WITHOUT DEPOSITING A COIN?

Only on calls to "operator" or by dialing the code for test desk or permanent signal trunks. On other calls, if the number is dialed before the coin is deposited the registers will take their setting from the dial but selection of the called line will not take place until a coin is deposited. On free calls such as to the business office, repair clerk, information desk, etc., the coin will be returned when the calling party hangs up. In the case of long distance, the coin will be automatically returned when the toll operator answers.

5. WHY IS THE DIAL COIN BOX CUSTOMER ABLE TO DIAL "OPERATOR", TEST DESK OR PERMANENT SIGNAL TRUNKS WITHOUT DEPOSITING A COIN?

In the case of "operator", this arrangement permits emergency calls to be made through the operator if a customer has no coin available. The provision for securing the test desk or permanent signal trunks without depositing a coin is to facilitate plant maintenance operations.

6. WHAT IS THE NORMAL SPEED OF A STATION DIAL? WHAT IS THE APPROXIMATE RELATIVE LENGTH OF OPEN CIRCUIT TO CLOSED CIRCUIT FOR EACH DIAL IMPULSE?

The normal speed is 8 to 11 impulses per second. The circuit is open approximately 66% of the time and closed 34% of the time for each pulse.

7. WHAT ARE THE MOST COMMON CAUSES OF PRELIMINARY IMPULSES?

The most common causes of preliminary impulses are a movement of the switchhook when the customer removes the receiver and when a P.B.X. attendant plugs into a trunk.

8. IS THERE ANY DIFFERENCE BETWEEN STATION EQUIPMENT USED IN MANUAL EXCHANGES AND PANEL DIAL OFFICES?

The station equipment used in connection with panel dial offices is substantially the same as that used in manual offices with the exception of the dial which is added to transmit the number of the called party. The station equipment used in panel offices is wired so as to eliminate noises to the calling subscriber, caused by dialing, and to short circuit the transmitter in order to overcome its variable resistance and make the line conditions more nearly constant while the impulses are being sent to the central office.

9. WHAT HAPPENS IF THE DIAL IS FORCED BACK TO NORMAL?

The dial when released is driven back to normal by a motor-spring the speed of its return being regulated by a governor. If the speed at which the dial returns to normal is too great, a wrong number may be registered.

10. WHAT INDICATION WOULD A CUSTOMER GET SHOULD HE DIAL A NUMBER THAT IS NOT WORKING?

All unassigned numbers are connected to answering jacks in the dial "A" switchboard and are answered by an intercepting operator when an unassigned number is called. The intercepting operator will inform the calling party the status of the line called and will connect the customer to "information" if necessary.

11. WHAT WOULD HAPPEN IF ONE CUSTOMER ON A PARTY LINE REMOVED THE RECEIVER FROM THE HOOK WHILE ANOTHER PARTY ON THE SAME LINE WAS DIALING A NUMBER?

There can be different results dependent upon how long the customer kept the receiver off the hook.

- (A) If the customer kept the receiver off the hook it would act the same as a short circuit upon the line and prevent the dial impulses from being transmitted to the sender. This would result in a partially dialed number or a permanent signal. The sender monitor would answer and instruct the second calling party to hang up his receiver until the first party completed his call. The first party would also be requested to hang up his receiver, wait a few seconds and then again proceed to place his call.
- (B) If the party hung up as soon as he heard the other party dialing without advising the party that his call had been interfered with, the dial impulses during that period would not be transmitted to the sender. This would result in either a partially dialed number or the registration of a wrong number. In the case of the partially dialed number the sender monitor operator would answer and instruct the customer to dial again. In the case of the wrong number being registered the call would go through to the wrong number or if there were no such working number, to the intercepting operator.

12. WHAT IS THE METHOD OF HANDLING DIRECTORY ERRORS INVOLVING THE LISTING OF A CUSTOMER UNDER A WRONG TELEPHONE NUMBER?

There are two general cases of improper number listings as follows:

- (A) Customer's number incorrectly listed as a non-working number in either a dial or a manual office.

Calls for the listed number will be intercepted. Calling parties will be advised of the correct number of the customer desired and will be instructed to originate a call for this number. In some cases, it may be possible and desirable, where the incorrectly listed number is in the same office as the correct number, to change the customer's number to the number listed.

- (B) Customer's number incorrectly listed as a working number in either a dial or manual office.

The customer incorrectly listed will be given his correct number. The customer correctly listed will be given a new number which can be a permanent or temporary number, depending on the customer's preference. The listed number will be intercepted and the calling party will be advised as to the correct number to dial.

13. WILL REPAIRMEN TEST SETS BE EQUIPPED WITH DIALS?

Yes.

14. IS IT NECESSARY TO BIAS BELLS AT A DIAL SUBSTATION?

Yes. All the station bells on a main line or party line should be poled and biased in accordance with the instructions given in the handbook of substation equipment, to prevent bell tapping on the dial impulses.

15. HOW ARE CALLS BETWEEN STATIONS ON THE SAME PARTY LINE MADE?

Each party line customer is provided with a card which is kept up to date, showing the telephone numbers connected to his line and is instructed to dial the "operator" when he desires to call one of the stations on this list. The "operator" requests the calling party to hang up for a moment and then selects an idle dial trunk and dials the desired number.

16. WHAT INDICATION DOES THE CUSTOMER GET IF ALL LINE FINDERS OR SENDERS ARE BUSY WHEN HE ATTEMPTS TO MAKE A CALL?

No indication except dial tone is not received by the customer under either of the above conditions. When a sender and line finder become available the customer hears the dial tone. In the case of a manual system the customer does not get any indication when all operators are busy.

17. WHO CONTROLS THE DISCONNECT? CAN THE CALLED PARTY ORIGINATE A CALL AFTER HANGING UP BEFORE THE CALLING PARTY TO WHOM HE HAS BEEN TALKING HANGS UP? HOW LONG CAN HIS LINE BE TIED UP IN THIS WAY?

The calling party chiefly controls the disconnect and the called party cannot originate a call until after the calling party hangs up. When the calling station disconnects all apparatus involved in the connection returns to normal. If the called party does not disconnect, the final selector is automatically released after a predetermined interval. The line will then be seized by a line finder and if the switchhook is not depressed or dialing started after a second interval of from one half to one minute a signal will appear at the sender monitor position of the dial "A" board. In case the called party disconnects and the calling party is still on the line, the district time alarm is operated after an interval of 2 to 4 minutes which calls the condition to the attention of the switchman.

18. ON WHAT "3 DIGIT" CALLS CAN THE CUSTOMER FLASH THE OPERATOR?

The customer can flash on calls to "operator" and "long distance".

19. WHAT WILL HAPPEN IF THE CALLING PARTY WORKS THE SWITCHHOOK AFTER DIALING?

On all calls except to "operator" and "long distance", the working of the switchhook by the calling party will probably cause the selectors, etc., which had been connected to his line to be disconnected and if the receiver remains off the switchhook the call will then appear as a permanent signal and will be answered by the sender monitor operator. However, whether or not the switches are disconnected depends upon the length of time the switchhook is depressed. The district circuit is arranged for a safety interval of 0.25 seconds so that an accidental depression of the switchhook will not cause disconnection.

20. IS DIALING AFFECTED BY VARYING LINE CONDITIONS?

The line insulation and capacity across the line or from line to ground affect the character of the dial impulses. To insure satisfactory operation of the dial the same line insulation and capacity limits should be obtained for dial stations as are observed in machine ringing manual districts. High resistance shorts or grounds which do not operate the line relay may affect the dial impulses. Short circuits which will operate the line relay will cause a permanent signal. Such a signal will be automatically routed to a permanent signal holding line and later if necessary be connected to a plugging up circuit.

21. WHAT IS THE INTERVAL OF TIME BETWEEN THE REMOVAL OF THE RECEIVER FROM THE SWITCHHOOK AND THE TIME THE DIAL TONE IS HEARD?

The dial tone circuit is connected to the line when the sender selector selects an idle sender and the line finder finds the line. In general the dial tone is heard about one half second after the removal of the receiver from the switchhook. The theoretical point at which the subscriber starts to dial the first letter of the office code on the dial is 1.7 seconds after the removal of the receiver.

22. IN OFFICES USING FOUR PARTY SEMI-SELECTIVE RINGING WHAT MEANS ARE PROVIDED TO APPLY THE PROPER RINGING CURRENT OF ONE OR TWO BELLS?

Final selectors are arranged in choices, each choice serving 500 terminals. Terminals numbered 0000 to 0499 inclusive are in choice "0", 0500 to 0999 choice "1" and 9500 to 9999 choice "19".

In offices arranged for 4 party semi-selective ringing choice "0" (0000 to 0499) and alternate choices following are arranged to give a code ring of one, while choice "1" (0500 to 0999) and alternate choices following are arranged to give a code ring of two. To provide an even distribution of traffic in all choices as well as utilize the equipment to capacity, individual, P.B.X. and 2 party lines will be assigned to the two bell choices if necessary.

23. IN CASE A P.B.X. REQUIRES OVER 100 TRUNKS HOW WOULD THE TRUNKS BE ARRANGED?

The limit of a final frame is 100 lines per group or 100 trunks outgoing to the P.B.X. By changing the trunks to one way, it would be possible to secure a total of 200 trunks, 100 outgoing and included under the final terminal listing and 100 incoming to the central office. For testing purposes the incoming trunks would be given an unlisted final terminal number. An ultimate of 200

trunks will undoubtedly in the case of the Bay Area care for the requirements to any P.B.X. for an indefinite period. It would be possible to further increase the number of trunks by providing additional final frames and sub-grouping that particular choice. It is also necessary in the case of any final choice having a heavy volume of traffic due to large P.B.X. groups and which traffic exceeds the capacity of a final frame, that is, 60 trunks or final selectors, to provide more than one final frame per choice.

24. HOW ARE RURAL LINES HANDLED IN PANEL OFFICES?

Farmer and suburban lines either magneto or common battery would be terminated on the D.S. "A" switchboard and handled the same as at a manual exchange.

"B" SWITCHBOARD - MANUAL OFFICE

CALL INDICATOR

1. CAN "B" OPERATORS IN ADJACENT "RELAY CALL INDICATOR" POSITIONS ASSIST EACH OTHER OR DO TEAM WORK?

Yes, provided the trunks are machine ringing. The trunks nearer the adjacent position are wired and equipped so that the adjacent "relay call indicator" operator may depress a teamwork display key and the desired number will be displayed on her "call indicator".

2. CAN A "B" OPERATOR IN A "CALL CIRCUIT OR STRAIGHTFORWARD" TRUNK POSITION ASSIST THROUGH TEAM WORK, THE "B" OPERATOR IN AN ADJACENT "RELAY CALL INDICATOR" POSITION?

No. "Call circuit or straightforward" positions are not equipped to handle call indicator trunks on a team work basis.

3. CAN "B" OPERATORS IN "CALL INDICATOR" POSITIONS HANDLE CALL CIRCUIT OR STRAIGHTFORWARD TRUNKS IN ADJACENT POSITIONS?

Yes, by the operation of the grouping keys.

4. CAN "B" OPERATORS IN "CALL CIRCUIT OR STRAIGHTFORWARD TRUNK" POSITIONS HANDLE CALL INDICATOR TRUNKS IN ADJACENT POSITIONS?

Yes, when the busy test lead associated with the call indicator trunks are switched to her operator's telephone set.

5. WHAT TEST NUMBER DOES THE SWITCHMAN CALL FOR TESTING ON THE CALL INDICATOR TRUNKS AND HOW DOES THE "B" OPERATOR HANDLE CALLS TO THE TEST NUMBER?

The test number used in connection with the call indicator equipment will be "0000". When this number is displayed the "B" operator will insert the plug of the associated trunk into the test jack designated for this purpose unless it is busy in which case the trunk will be connected to a busy back jack.

6. IN WHAT ORDER ARE THE DIGITS REGISTERED IN THE CALL INDICATOR EQUIPMENT?

There will be 5 digits registered for each number on the call indicator. For numbers over 9999 the ten thousands digit will be registered first, for numbers less than 10000 without station suffix the ten thousands digit 0 will be registered first, and will indicate that no party line designation is required, for party line numbers less than 10000 the station digit corresponding to "W", "R", "J", or "M" will be registered first. The remaining thousands, hundreds, tens and units digits will then be registered in that order.

7. WHY IS IT NOT POSSIBLE IN JACK PER LINE MANUAL OFFICES HAVING NUMBERS HIGHER THAN 9999 TO HAVE PARTY LINES ASSIGNED NUMBERS HIGHER THAN 9999 OR NUMBERS BETWEEN 1000 AND 1099?

The party line suffixes "W", "R", "J" and "M" are equivalent to the numerals "9", "7", "5" and "6" respectively. As the call indicator circuits are designed to only display a total of 5 characters, the use of party line suffixes between 10000 and 10499 would require the display of six characters which condition for the small number of lines involved would not be economical. Party line suffixes cannot be used between 1000 and 1099 because when the first two numerals dialed are "10", the apparatus will display the "1" in the ten thousands group of lamps or in the thousand group, depending on whether a total of five or of only four characters are dialed for the station number. For instance, 1037 R when dialed would be displayed the same as if 10377 had been dialed, whereas 1037 if an individual line would be displayed as 01037.

8. CAN "CALL INDICATOR TRUNKS" BE USED AS "STRAIGHTFORWARD" TRUNKS?

Yes. Convertible type of trunks are provided when necessary to meet traffic requirements. In this case the key listening method will be used and the display key is used as a listening in key.

9. CAN THE "A" OPERATOR RE-RING ON "CALL INDICATOR" TRUNKS USED AS "STRAIGHTFORWARD" TRUNKS?

No. The operation of the trunk will be the same as the regular straightforward trunk.

10. WHAT HAPPENS SHOULD THE CALL INDICATOR OPERATOR DEPRESS THE DISPLAY KEY OF A TRUNK NOT SELECTED AT THE PANEL OFFICE?

The peg count register is operated but no other operations take place. The operator should only depress the display key of a trunk having its assignment lamp lighted and its disconnect lamp extinguished.

11. WHAT HAPPENS SHOULD A CALL INDICATOR OPERATOR DEPRESS A SECOND DISPLAY KEY BEFORE DISPOSING OF THE PREVIOUS CALL?

The depression of the second key will change the assignment lamp on the first trunk from a flashing to a steady signal and the called number associated with the second trunk will then be displayed on the call indicator.

12. WHAT HAPPENS SHOULD A CALL INDICATOR OPERATOR FAIL TO REMOVE THE PLUG OF A TRUNK ON WHICH THE DISCONNECT LAMP IS BURNING?

This condition will not prevent the selection of the trunk for another call by the selectors at the panel office. The assignment lamp lights. The assignment and disconnect lamps burning indicate that the parties on the first connection have disconnected and that the trunk has been selected for another call. Ringing current is not connected to the trunk. By removing the plug from the multiple jack and depressing the display key the call waiting on the trunk is displayed on the indicator.

13. WHAT HAPPENS SHOULD THE CALL INDICATOR OPERATOR REMOVE THE TRUNK PLUG DURING CONVERSATION?

Removal of the plug will cause the assignment lamp to re-light. If the calling party does not hang up before the connection is restored the ringing periods will again take place as soon as the plug is re-inserted in the called station jack. If the called party has not replaced his receiver, the tripping relay will operate at once and remove the ringing current.

14. WHAT HAPPENS SHOULD A PARTY ABANDON A CALL INDICATOR CALL WITH THE NUMBER PRACTICALLY DIALED?

The sender circuit in the panel office is arranged to release should the customer abandon the call before the call indicator operator depresses the display key, whether or not he has dialed the complete number. The customers line is released immediately the receiver is replaced on the hook.

15. HOW WILL CALL INDICATOR TRUNKS BE MADE BUSY?

The trunks from a machine switching office to a call indicator position may be made busy, thereby preventing their being selected on any calls, by operating the "make busy" key associated with that particular group. These keys are located at the call indicator positions and are under the control of the traffic operating forces. Certain call indicator boards may not be equipped with "make busy" keys depending upon the amount and grouping of the incoming traffic from the panel offices.

16. SHOULD TROUBLE OCCUR IN THE LAMP DISPLAY UNIT OF A CALL INDICATOR POSITION WILL THIS POSITION BE COMPLETELY OUT OF SERVICE UNTIL THE TROUBLE IS REPAIRED?

No. Immediate traffic can be relieved by team operation of the adjacent positions to the right and left of the position in trouble. Emergency equipment is also provided as follows:

A set of call indicator lamps mounted in a box arranged to be secured to the keyshelf in such a manner that the top of the box lines up with the top of the keyshelf. The box is equipped with a multi-contact plug to be inserted into the multi-contact jacks mounted in the keyshelf rail at the right end of each call indicator position, wired to associated emergency common relay equipment.

17. WHAT IS MEANT BY UNIVERSAL PULSING?

Universal pulsing is a circuit development by means of which it is possible to complete calls routed direct from a panel dial office to a manual office (via call indicator) over trunk loops with a varying resistance up to 2640 ohms.

Note:

In the older panel dial offices the senders are not arranged for universal pulsing. It is then necessary to have two "MG" marginal relays with call indicator control circuit of the positions in which terminate trunks of both high and low resistance. Trunks of approximately the same resistance are grouped together and connected to the same "MG" relay.

18. WHAT IS THE PURPOSE OF THE FINAL HEAVY POSITIVE PULSE?

The final heavy positive pulse is only used when machine switching offices are equipped with two wire office selectors in which case it is used to advance the office selector at the completion of the pulsing period. The two-wire office selectors function as a tandem arrangement and accordingly, like other forms of tandem equipment, are used where economies are effected in the inter-office trunk plant. For the present, two wire office selectors will not be used in the Bay Area.

DIAL SYSTEM "A" (D.S.A.) SWITCHBOARDS

1. WHY ARE NOT THE "D.S.A." SWITCHBOARDS FOR THE DIAL OFFICES CENTRALIZED AT ONE POINT?

In the smaller multi-office areas having dial equipment where small operating forces are involved and where it is necessary to handle very little or no A-B traffic at the "D.S.A." board, centralized arrangements are in certain cases economical. The question of trunk transmission for calls handled through the "D.S.A." board also offers special problems. Another limitation at present is the collect and refund pre-payment coin box station operation with the coins controlled directly from the "D.S.A." operators cords.

Consideration is being given to the above limitations and other factors and it may be found practicable and advantageous to provide centralized equipment at some future date.

2. WILL THE "D.S.A." OPERATOR RECEIVE SUPERVISION ON CALLS COMPLETED BY HER TO NUMBERS IN CALL INDICATOR OR DIAL OFFICES TO WHICH THE CALLING SUBSCRIBER IS ENTITLED TO FREE SERVICE?

If calls to the number are free, the operator will not receive direct supervision and the front supervisory signal will be lighted during conversation the same as if the called station was being rung. If the line is busy or if a trunks busy condition is encountered, the standard signals for such conditions will be received by the "D.S.A." operator.

CORDLESS "B" SWITCHBOARD

1. WHY ARE TWO KEY CONTROL CIRCUITS PER POSITION NECESSARY?

One is located on one side of the selector frame and one on the other side so that in case of a motor or key control circuit failure the position can be kept in service by patching the entire position to one key control circuit. Also the holding time of a key control circuit is longer than the time required by the operator to set up a call. It is therefore necessary to efficiently handle the traffic during the busy periods to have two key control sets so arranged that they are allotted alternately as the operator depresses her assignment key.

2. WHY ARE TWO ALLOTTERS NECESSARY?

One is located on one side of the frame and one on the other so in case of a motor or allotter failure the position can be kept in service by patching out the allotter in trouble which at the same time allows the remaining allotter to assign all links in the position.

3. WHAT PROVISION IS MADE FOR A FAILURE OF THE POSITION KEYSSET?

In order to preclude any considerable delay in handling calls due to a position being out of order, caused by conditions resulting in the failure of the recording keys and associated equipment to function properly, one or more sets of emergency key equipment per office will be provided. In case of a failure of a position key set, the traffic department will, by means of lamp and alarm signals in the switchroom, notify the maintenance force of this condition. On receipt of the alarm signal, one of the sets of emergency key equipment will be substituted for the regular keys by inserting it in the keyboard space, after removing the regular keyset.

4. WHY IS THERE A SET OF KEY CONTROL RELAYS FOR THE THOUSANDS AND TENS AND ANOTHER FOR THE HUNDREDS AND UNITS KEYS?

To allow for the restoring of the relays between digits.

5. WHY IS CORDLESS INCOMING TRUNK CIRCUIT ES-20070-01 REVERSED ON THE TRUNK SIDE?

To prevent the "A" relay from being released should the trunk circuit be momentarily opened as would occur should the "A" operator withdraw her plug and noticing her error immediately replace it.

The theory of the operation is described using both a regular connection as for manual trunks, and a reversed connection as specified for cordless "B" trunks.

With a regular connection the current in the trunk windings of the incoming selector repeating coil magnetizes the repeating coil core in the opposite direction to the magnetization caused by the current in the called subscriber line windings and the resultant magnetization with current in both windings is less than the magnetization with current in the called line only. Therefore, when the "A" operator removes the plug the magnetization increases. The electromotive force induced in the trunk windings when the magnetization of the core is increased is opposite to the electromotive force required to produce an increase in the magnetization. The current through the "A" relay is therefore decreased tending to release this relay.

With a reversed connection both the current in the trunk and called line windings of the incoming selector repeating coil magnetizes the core in the same direction and the resultant magnetization with current in both windings is greater than the magnetization with current in the called line only. Therefore, when the "A" operator removes the plug the magnetization decreases and the current induced is in the same direction as the current which operated the "A" relay, therefore tending to keep the "A" relay operated for a longer period of time than when the regular connection is used. The "A" is also of the slow release type to further improve this condition.

6. WHY ARE THE LAST FIVE PAIRS OF COUNTING RELAYS IN THE CORDLESS "B" SENDER CONNECTED BETWEEN THE NO.1 PAIR OF COUNTING RELAYS AND NO.2 PAIR OF COUNTING RELAYS? WHY ARE NOT THE COUNTING RELAYS IN THESE CIRCUITS WIRED TO COUNTING LEADS IN THE SAME MANNER AS IN THE SUBSCRIBERS' SENDER?

In the cordless "B" equipment numbers are registered by operating or non-operating register relays over control leads.

Four register relays numbered 1, 2, 3, and 4 are used to connect the contacts of the stepping relay in the sender to the counting relay leads. Relays numbers 1, 2, and 3 determine whether counting lead number 0, 1, 2, 3 or 4 is connected to the contacts of the stepping relay. The operation of the No.4 register relay causes five additional pairs of counting relays to be connected, thereby making five more pulses necessary to satisfy the sender, which is equivalent to connecting counting leads number 5, 6, 7, 8 or 9.

Rotary switches are used for registering the numbers dialed into a subscriber sender making registration of the called

number in register relay groups necessary in a two digit sender, the terminals of the rotary switches being directly connected to the counting leads.

7. WHAT DIFFERENCE IS THERE BETWEEN A FLASHING AND A FLICKERING LAMP AT THE CORDLESS "B" SWITCHBOARD?

A flashing lamp circuit is operated through interrupter springs closed about 0.5 second and then opened about 0.5 second while a flickering lamp is operated through interrupter springs closed about 0.2 second and opened 0.2 second.

8. WHAT IS MEANT BY OVERLAP ON CORDLESS "B" POSITIONS AND UNDER WHAT CONDITIONS IS IT USED?

Overlap refers to the arrangement of trunks on a cordless "B" switchboard whereby an operator at one position handles a certain number of trunks on one or both of the adjacent positions. The overlap method of operation is used where the trunk capacity of the position is insufficient to properly load an operator as in the case of incoming trunks having a comparatively long holding time. The trunks which are overlapped are permanently connected to the adjacent position.

SELECTORS

1. OF WHAT DOES A PANEL SELECTOR CONSIST?

A panel selector consists essentially of one multiple brush for each bank on the frame, a brush support rod on which the brushes are mounted, a trip rod with a trip finger for each brush, a commutator and commutator brush, a rack and a clutch unit which consists of an up drive magnet, down drive magnet and a trip magnet. Associated with the panel selector are relays, sequence switches, etc., and in general are also included in the term "Panel Selector".

2. HOW ARE BRUSHES TRIPPED AND WHAT CONTROLS THE TRIPPING OF A PARTICULAR BRUSH?

For Panel Selector frames the operation is as follows:

The trip rod which is mounted vertically behind the brush support is rigid as regard to up and down movement, but is arranged so that it can be rotated. Each rod is equipped with a trip finger at each multiple brush, the trip fingers being set at different heights relative to their associated brushes.

In selecting a particular brush, the brush support rod moves upward until the tripping device on the brush desired is opposite its associated trip finger. In this position the trip fingers corresponding to the other brushes on the rod are not opposite the tripping device. The trip magnet operates and causes the trip rod to revolve, which brings the trip finger to the tripping position and at the next upward movement of brush support rod, the selected multiple brush is tripped. On the return of the selector to normal position, the tripped brush is restored to its normally open position.

Line finder-frames are provided with horizontal trip rods located at the bottom of each multiple bank. Each trip rod is provided at the end of the multiple bank with a trip magnet capable of rotating the rod through a small angle. The number of trip fingers carried by each rod and consequently the number of line finders served by the rod, depends on the type of multiple bank with which the frame is equipped. In the case of 28-28 frames, the rod on each side of the bank is provided with fourteen fingers.

To guard against tripping two brushes on a line finder if two line finders associated with the same group of trip rods respond simultaneously to two calls appearing in two different banks, the circuits are so arranged that only one line finder will be operated.

3. HOW DO BRUSHES ON SELECTOR FRAMES OTHER THAN THE ONE TO BE TRIPPED PASS THE TRIP FINGER?

On all frames except the line finder frame the normal position of the trip rod will allow all brushes to pass the fingers without tripping; if the trip rod is operated to its maximum before the selector is moved off normal all brushes will pass the trip fingers. If, however, the selector is moved up to the tripping position of any particular brush and then the trip rod is operated the particular brush will engage the trip finger and hold it while the other fingers move to the maximum position. On the next upward movement that particular brush will be tripped. The trip fingers are equipped with a spring which allows one of them to engage with a brush while the other fingers move to the maximum position. After the particular brush has been tripped the trip finger that engaged it goes to the maximum position. On the line finder frame only the trip rod associated with the particular brush to be tripped is operated.

4. WHY ARE FOUR LINE FINDERS LOST IN SPLITTING LINE FINDER FRAMES 28 - 28?

To provide space for reversing the multiple between the sub-groups.

5. WHERE IS THE "HUNTING" TERMINAL IN THE LINE FINDER MULTIPLE BANK LOCATED?

It is located above and to the left of the sleeve terminal.

6. DOES A MOTOR FAILURE ON A LINE FINDER FRAME MAKE THE ASSOCIATED LINE FINDERS BUSY?

Yes.

7. ARE THE SELECTOR RACKS ON THE LINE FINDERS IN EACH SUB-GROUP SO NUMBERED SO THAT THE LINE FINDER TERMINALS CAN BE READ DIRECT?

No. The line finder terminals are read direct on the selector rack in sub-group "A" but in sub-group "B" the line finder terminals are obtained by subtracting the rack reading from 39.

8. HOW IS THE CAPACITY EFFECT BETWEEN TERMINALS OF SELECTOR FRAME MULTIPLE BANKS NEUTRALIZED AND WHY IS THERE NOT CROSS TALK BETWEEN ADJACENT LINES?

A series of holes is punched out of the body of each metal terminal strip to reduce the weight of the bank and the

amount of metal exposed and the sleeve terminal strip is also placed between the tip and ring strips of adjacent lines which shields one circuit from another.

9. WHY DO THE TRIP MAGNETS OF THE FINAL SELECTORS OPERATE ON THE RETURN ON BUSY OR PREMATURE RELEASE?

The trip magnets operate when the final selector sequence switch reaches the return on busy and premature release so that there will be no danger of the trip fingers catching the brushes as the selector returns to normal in case the final has not advanced beyond the brush tripping zone.

10. WHAT USE IS MADE OF THE SEQUENCE SWITCH?

A sequence switch is a device used in panel dial offices for establishing and changing circuit connections as required, performing in general the functions of a relay or of a group of relays. In addition, the sequence switch is constructed and operated in such a way that two or more circuit changes may be affected in a definite time sequence, a much wider latitude being afforded in this respect than with the ordinary type of relay.

11. WHERE AND HOW ARE THE TRIPPED BRUSHES RESET?

The brushes are reset at the bottom of the bank as they are driven down to normal by the trip levers coming in contact with the resetting plate.

12. HOW ARE THE "TIME ALARMS" OF THE VARIOUS SELECTORS MEASURED?

An interrupter in connection with relays or selectors provides the means for the measuring of all time alarms. These interrupters known as the "bar" type are motor driven at a constant speed through the use of a vertical drive shaft and by means of gears and cams it is possible to open and close contacts for predetermined periods which count time by means of relays or rotary selectors.

13. WHY IS IT NECESSARY TO CUT CAM "O" FROM 6/8 IN THE INCOMING CORDLESS SELECTOR CIRCUIT (ES-20070-01)?

To prevent the trip fingers from being damaged should the "B" operator depress the disconnect key when the sequence switch is in position No.6 and the brush rod was just at the right position for the trip finger to be prevented from returning to normal. The 6/8 cutting insures the operation of the trip magnet until after there is danger of damaging the springs.

14. HOW ARE CONTRACTION AND EXPANSION OF SELECTOR BRUSH RODS TAKEN CARE OF?

There is not enough difference between the contraction and expansion of the brass selector brush and the steel frame to cause operating trouble such as overstepping. There will be a noticeable difference in checking the adjustments of the selectors at different temperature. The adjustments should be checked at the same temperature at which the adjustments were made.

15. IN WHAT TALKING POSITION DOES THE DISTRICT SEQUENCE SWITCH STOP ON DIFFERENT THREE DIGIT CALLS?

On calls to "operator" and "long distance" the district sequence switch passes to "talking to operator" position and the district selector repeating coil is cut out. Talking battery is supplied to the subscriber from the "operators" cord circuit or from the recording trunk circuit. On calls to "information" and to "repair clerk" the switch passes to the "trunk" talking position and talking battery is supplied through the repeating coil in the district selector.

16. WHAT IS MEANT BY "TELL-TALE"?

"Tell-tale" is the highest commutator to which a line finder or a selector travels when due to circuit trouble or an abandoned call the line finder or selector travels past the top terminal in the bank. Ordinarily it will cause the line finder or selector to return to normal, however in certain cases alarms are given to indicate that the selector failed to return to normal.

17. WHY IS THE "G" COMMUTATOR IN THE DISTRICT SELECTOR CIRCUIT CONNECTED TO GROUND THROUGH THE CONTACTS OF THE "L" RELAY WHEN THE DISTRICT SELECTOR IS TRUNK HUNTING?

When the selector is trunk hunting the "L" relay is held operated alternately to ground at the sleeve terminals of busy trunks and to ground through the "C" commutator, "G" commutator and contacts of the "L" relay. When an idle trunk is reached the "L" relay releases, quickly removing the ground from the "G" commutator and hence the "C" commutator insuring that the selector will stop in the proper position. If ground were furnished to the commutators in the usual way there would be a greater possibility of the selector overstepping, since the brush rod, because of its inertia, might reach the next commutator segment which would be grounded and would cause the selector to pass to the next set of terminals, whereas with the scheme used, the ground to the commutator would have been cut off by the rapid release of the "L" relay. This scheme is used under other similar conditions.

18. WHAT WILL HAPPEN IF TWO FINAL SELECTORS ON THE FINAL SELECTOR FRAME ARE STARTED SIMULTANEOUSLY, HUNTING FOR THE SAME TERMINALS AND STOP ON THE TERMINALS OF THE CALLED LINE AT THE SAME TIME?

A double connection will result. Because of the rapid operation of the selectors the probability of a double connection is very small.

19. WHAT WOULD RESULT SHOULD TWO DISTRICT SELECTORS ARRIVE ON THE SAME OVERFLOW TERMINAL SIMULTANEOUSLY?

Both district selector "L" relays would release simultaneously when the selector brushes arrived on the overflow terminal because the sleeve lead of the overflow trunk is open. When the "L" relays release the sequence switches advance out of position No.8 into position No.9. In position No.9 there is no connection between the two district selector circuits over the sleeve leads because of the open at the "0" segments of their commutators. The two senders used to control the selections of the district selectors would get the overflow test over the tip to the common overflow register circuit and both senders would advance to the talking selection position and both district selectors would be advanced to district overflow position No.17 where the subscribers would hear the paths busy tone and release in the regular manner.

20. ASSUMING A MESSAGE REGISTER IS BEING OPERATED WHILE A LINE FINDER IS TRAVELING OVER THAT PARTICULAR TERMINAL, WHAT WOULD BE THE EFFECT ON A LINE FINDER HUNTING A TERMINAL ORIGINATING A CALL?

The current through the "H" relay (500 ohms) in the line finder circuit when the line finder brush is in contact with the "H" lead of a line and the message register (5 ohms) is being operated, will be about 0.003 ampere. Obviously the line finder "H" relay will not operate when the line finder brush is in contact with the "H" lead over which the message register is being operated.

21. WHAT IS GRADED MULTIPLE?

Graded multiple is an arrangement for associating a group of trunks with several district or incoming frames in such a way that some of the trunks are multiplied through all the frames involved, while the remaining trunks are arranged in two or more groups, each group being multiplied to only a part of the frames. The trunks multiplied through all the frames are known as "common trunks" while those multiplied through only a part of the frames are known as "individual trunks". The individual trunks are always below the common trunks and are therefore first choice to

the selectors before which they are multiplied. A number of the trunks may be so cabled that they may be used either for common or individual trunks by the changing of cross-connections and are known as "convertible trunks" and would be located above the individual trunks. In certain cases the traffic requirements may be such that the entire trunk group will be "convertible" and certain trunks used as individual and the remainder as common trunks.

22. WHY DOES THE WIRING ARRANGEMENT FOR THE DISTRICT FINDER MULTIPLE ON THE LINK FRAME DIFFER FROM THE USUAL PANEL SELECTOR FRAME?

The district finder multiple bank differs from the usual construction of multiple banks in that the bank terminals are arranged in multiples of 2 instead of 30 as in the district or incoming multiple banks. This allows for one row of soldering lugs for the terminals appearing before every two links with the exception of the last link which has an individual row of lugs. Cables from the district selectors are brought to the banks from above and soldered to one of these rows of soldering lugs. The soldering lugs for terminals appearing before other links are then connected to the district selectors by means of horizontal strapping. This arrangement allows for great flexibility since the cutting or adding of the horizontal strapping between rows will directly increase or decrease the number of links having access to a particular group of district selectors.

23. DOES A LINK CIRCUIT RETURN TO NORMAL POSITION AFTER BEING USED?

The link circuit after being released from a call advances into position so that the district finder selects and holds an idle district and advances into position awaiting allotment and is on the "stay put" basis at all points on its bank. The link sender selector returns to normal only provided the sender from which it was released was one of the last 10 or 20 senders in the bank, depending on arrangement of commutator. In case the sender is below the upper 10 or 20 terminals, the sender selector "stays put" on the terminal previously in use. When the link is again selected, the sender selector tests and if the previously used sender is not busy, it is again selected. If busy the sender selector hunts for an idle sender.

SENDERS

1. WHAT IS THE FUNCTION OF THE SENDER?

The principal functions of the sender are:

- (a) To return a dial tone to the calling subscriber to indicate that the equipment is receptive to dial pulses.
- (b) To receive and register the impulses dialed by the calling subscriber.
- (c) To translate these impulses from the decimal system as dialed into the proper settings on the registers and translator for making the necessary selections on the panel type selectors.
- (d) To set up by means of the class register the circuit conditions for completing the call to the particular class of office in which the called station terminates.
- (e) To control the selections on the various selectors as required to complete the connection.
- (f) To translate the register settings into the proper pulses to set up the required number on the call indicator if the called station is in a manual office.
- (g) To give suitable alarms after a predetermined length of time in case the completion of the call is held up at any point in its progress.
- (h) To give a signal to the sender monitor at the "D.S.A." board in case the call is held up due to improper dialing or failure of the equipment during the time the selections are being made.
- (i) To release the calling subscriber's line upon the replacement of the receiver on the switch-hook at any point in the process of the connection prior to the release of the sender.

2. WHAT IS MEANT BY CLASS OF CALL AND HOW DOES THE SENDER DISTINGUISH BETWEEN THE CLASSES?

Class of call is determined by its termination, that is according to whether the call is to a dial or a manual office. Class distinction is also given calls to "Operator" and special codes calls requiring special routes.

For each particular class a predetermined combination of pulses are connected to the translator frame terminals and cause certain class register relays in the sender circuit to operate. The class register relays determine the setting of a class sequence switch in the predetermined, proper position for the particular call desired.

The sender circuit is so arranged that the normal position for the class switch is for an "Operator" class call, therefore translation is not required for this class of call.

3. WHAT IS THE MEANING OF "TRANSLATOR"?

The "translator" is that part of the equipment which from the setting of the registers determines the class of call and the proper routing and necessary circuit arrangement for completing the trunk selection.

The translator used in the San Francisco and East Bay Areas is a panel type selector which under the control of the office code registers, selects a predetermined terminal for the particular office code dialed. This terminal is permanently connected to a combination of pulse drums which cause the proper setting of the sender register relays which in sequence control the destination of the particular call.

4. WHAT ARE THE FUNCTIONS OF THE "COUNTING RELAYS" IN THE SENDER CIRCUIT?

The "counting relays" are used for controlling the selections made by the selectors and are a part of the fundamental selecting circuit for making the brush and group selections on the district, office and incoming frames, and the brush, group and individual line selections on the final frame. The operation of the circuit is the same for making any one of the selections and the same set of counting relays in the sender is used for all selections, that is, the counting relays are used for making one selection then released and when the sender sequence switch reaches the next selecting position are again used for making that selection.

Briefly, each selector as it moves upward sends pulses by means of its commutator. These pulses are counted by the counting relays and the sender stops the selector when the counting relays have received sufficient pulses, in accordance with the setting of the register relays when choosing a trunk or in accordance with the setting of the numerical registers when choosing a terminal in a panel office.

5. DOES THE SENDER SEND IMPULSES OR RECEIVE THEM ON CALLS BETWEEN TWO MACHINE SWITCHING STATIONS?

The sender receives impulses from the various selectors in connection with such calls.

6. WHAT ADVANTAGES ARE GAINED BY TRANSLATING DECIMAL INTO NON-DECIMAL CODES?

The principal advantages are:

- (a) The office code and routing are entirely independent. That is, the office name has no direct relation to the outgoing trunks to a particular office. This permits of selecting and grouping of the trunks on the office and district to the best advantage.
- (b) Office names need not be changed due to rerouting of trunk plant through office frames, tandem centers, etc., thereby securing maximum efficiency of trunk plant. These changes in routing are easily accomplished by changing the translator crossconnections.

7. WHAT IS THE MEANING OF 3 - 2 DIGIT SENDER?

A 3 digit sender is one which requires the dialing of three office code letters. A 2 digit sender requires the dialing of two office code letters. A 3 - 2 digit sender is one which can be arranged for dialing either 3 or 2 office code letters.

In the case of the Bay Area, the 3 - 2 digit sender will be provided. Initially the office codes will consist of two digits. At a future period, when the available two-digit office codes are assigned, future offices will be assigned three-digit office codes. The numbers of subscribers in these later units will consist of an office name and five numerals, but the first numeral will be part of the office code. Subscribers dialing three-digit offices will follow the same practice as for two-digit offices, that is, dialing the first two letters of the office name followed by the listed number which will consist of five digits.

8. WHAT IS THE AVERAGE LENGTH OF TIME A 3 - 2 DIGIT SENDER IS USED ON EACH CONNECTION?

The average sender holding time through a district and office frame is as follows:

Calls from dial to dial office 16 seconds.
 Calls from dial to jack per line manual office 21 seconds
 Calls from dial to jack per station manual office 17 "

The above is for 2 digit operation. Calls to 3 digit offices increases the holding time about 2 seconds. Calls to party lines in jack per line offices, for numbers above 9999 or if a district frame only is used slightly change the above holding time.

9. DOES THE SENDER WAIT UNTIL THE COMPLETE NUMBER HAS BEEN DIALED BEFORE STARTING TO SELECT A TRUNK AND THE CALLED NUMBER?

Trunk selection is started on the district and office frame immediately upon the completion of dialing the office code and completion of translation and does not wait for the dialing of the station number.

Trunk selection on the incoming frame is started immediately upon dialing of the "thousand" and "hundred" digit.

In the case of "R.C.I." calls, the sender waits after selecting the trunk until the complete called number is dialed before proceeding with trunk closure and the lighting of the assignment lamp.

10. WHAT IS MEANT BY "PRIMING A SENDER"?

"Priming a Sender" is the term used to refer to the operation whereby the sender monitor operator on receipt of a stuck-sender or partial dial signal and after challenging or not receiving a disconnect signal removes the plug from the talking jack and inserts the plug momentarily into the priming jack. This will cause the sender to be released and restored to service. Whenever the plant forces are investigating the reasons for stuck-senders, the sender will not be primed but a "shutter" will be plugged into the priming jack to cover the sender signal and hold the sender.

11. WHY ARE "A" CAM AND "A" CAM SPRINGS OMITTED ON THE RELAY CALL IMPULSER SEQUENCE SWITCH?

The "A" cam and "A" cam springs on a sequence switch are used to control the circuits of the magnetic clutch and to center the switch in the desired position. In sending relay call indicator impulses, the sequence switch makes a complete revolution and it is not desired that it stop in any intermediate position, therefore, the "A" cam and "A" cam springs are not necessary.

12. WHY IS COIN BATTERY APPLIED TO BOTH SIDES OF THE LINE?

To decrease the current through the subscriber set receiver, should the subscriber attempt to originate another call before the sender collected or returned the coin, thereby reducing the danger of causing severe "bat" in subscriber's ear. The coin is collected or returned in from 3 to 5 seconds after subscriber disconnects.

13. HOW IS THE SENDER SATISFIED ON A CALL TO A NUMBER IN A "BLANK" CHOICE?

Calls for numbers other than those for which final terminals have been provided are connected at the incoming frames to

"blank" incoming trunks which terminate at the "A" switchboard. On such calls no final selections are made. These incoming trunks have interrupters arranged to send back impulses to the sender to replace those ordinarily sent back by the final selector circuit. The sender is satisfied in this way and the talking position obtained.

14. WHAT HAPPENS IF A CUSTOMER DIALS AN UNUSED CODE?

a. Initially the translator will be crossconnected so that calls to all vacant codes are routed to the "Operator" over a special group of trunks from the district multiple. The sender will cause the district brush and group selections to be made and when the talking position has been obtained the sender will be dropped. The excess digits which may have been dialed will have been registered and when the sender is released these registers will be restored to normal.

At some future period, the unused office codes which are not superimposed on working codes, may be connected to an unused office code tone. This tone is the same as the regular line busy signal except that every third pulse is omitted.

b. If the subscriber dials a code which is assigned to some working office in attempting to call a three-digit operator such as "Long Distance", "Repair Clerk", etc., it will result in a stuck sender as in the case of an incompleting call and a signal will appear before the Sender Monitor operator who will answer the call.

15. WHAT WILL HAPPEN SHOULD A CUSTOMER AFTER DIALING ZERO CONTINUE TO DIAL ONE OR MORE DIGITS? FOR EXAMPLE 0-1 OR 0-1-3.

When zero is dialed for the first digit, advancing the "A" register to terminal 0, a relay (Z0) will be operated, while the release of the RA relay will allow the RC selector to advance to terminal 9. Any succeeding digits dialed will merely pulse the sender L relay which will not affect the registering circuit.

16. HOW MANY DIFFERENT ROUTINGS MAY BE GIVEN A CALL UNDER 2 DIGIT OPERATION? UNDER 3 DIGIT OPERATION?

The number of routings which may be given is determined by the number of ways in which two or three digits may be arranged to form useful codes which may be dialed as well as practical names for use in manual operation. There are 64 possible letter combinations obtainable with two digit operation and 512 with full three digit operation. Not all of these combinations are actually available since for a number of the combinations such as 55, 85, 99, etc., for two digit and similar combinations using three digit codes, it is difficult to find a suitable name. This reduces the

available two digit codes to somewhat below 64 and considerably below 512 for three digit operation. For instance the 27 possible combinations of the code 999 (WXY) do not provide a suitable name.

Note:

The sender circuits to be used in the San Francisco and East Bay Areas will be arranged to operate initially as two-digit senders, subsequently as three - two digit senders and ultimately as three-digit senders. This flexible arrangement is made possible by the installation of three office code registers (A-B-C) and a panel type translator. With two-digit operation the office code will be registered on the A and C registers, the B register being skipped. Three - two digit operation is arranged for the registering of a two-digit code on the A and C registers and the registering of a three-digit code on all three (A-B-C) registers in the normal manner. The first digit of the office code dialed will determine whether or not the B register shall be skipped. The first digit of certain pre-selected office codes shall be associated with three-digit codes and the remainder associated with two-digit codes. The ultimate arrangement of full three-digit operation will require that all office codes have three digits which will be registered on the A-B-C registers in the normal manner.

17. WHAT IS MEANT BY THE OFF-NORMAL GROUND LEAD?

Under normal operation this lead is grounded upon the sender being seized. Ground from this lead operates the SB relay which opens the battery to the test lead. Throughout the entire function of the sender ground from this lead is used to complete various operating circuits which are controlled more desirably by an off-normal rather than a permanent ground. In addition the off-normal ground lead performs an important function in that it becomes grounded when any of the major portions (registers and sequence switches) of the sender circuit are either accidentally moved off normal by hand or become lodged off normal (during restoration) due to failure of some mechanical detail. The SB relay becomes operated as mentioned above thus preventing the sender being selected for a call while off normal.

18. WHAT IS THE FUNCTION OF THE TRANSLATOR FRAME?

The principal function of the translator frame is to provide a flexible means of connecting the register control relays of the sender to various combinations of sending drums of the pulse machine. This provides for setting the proper sender code register relays to determine the routing and trunk selection required in a call to any office.

Each sender has a set of 6 leads terminating on a selector at the translator frame. Each set of translator bank terminals is crossconnected to predetermined combinations of the sending drums of the pulse machine and a different combination is provided for each office code.

The setting of the A, B, and C (3 digit calls) or A and C (2 digit calls) sender registers determine the translator bank terminals at which the translator selector brushes stop.

19. WHAT IS THE FUNCTION OF THE PULSE MACHINE?

The pulse machine is provided for supplying to the multiple banks on the translator frames and to the sender, the electrical pulses of various combinations of battery and ground and consists of a series of sending, receiving and timing drums which are constantly revolving.

Various combinations of battery and ground pulses from the sending drums are required by the sender to control the operation of the code register relays. These relays then control the setting of the translator register relays from the receiving drum pulses. The setting of the relays in the translator register portion of the sender circuit determines the proper class, district office and talking selections and also controls other miscellaneous features. The setting for the district and office selection in turn selects the proper counting relays for selection of a trunk group to a particular office.

20. WHAT IS THE FUNCTION OF THE TIMING DRUM ON THE PULSE MACHINE?

The timing drum is provided to insure that the pulse leads will be connected to a particular sender during one complete revolution of the pulse drums thus providing for the proper settings of the register relays in the sender.

The timing drum is connected to counting relay No.6 in each sender and when seven contacts with the timing drum have been made the connections of the pulse machine drums through the translator to the register relays of the sender will be broken. As there are six segments to one revolution of the sending and receiving drums, seven pulse counts of the timing drum are required to insure one complete revolution of the pulse drums.

21. WHEN A PULSE MACHINE FAILURE OCCURS ARE CALLS IN PROCESS OF COMPLETION LOST?

No calls would actually be lost. A failure of the pulse machine stops translation in the sender. Therefore the sender will become stuck on all calls for which translation has not been

completed. After an interval of 30 to 60 seconds if a new machine has not been substituted in the meantime, a stuck sender signal will be displayed at the sender monitor position and the calls will be disposed of according to the usual practice.

DESKS

1. HOW DO REPAIRMEN IN DIAL AREAS CALL?

With a hand set equipped with a dial.

2. GIVE NUMBERS TO BE DIALED IN ORDER TO CALL OTHER THAN REGULAR SUBSCRIBERS' NUMBERS.

Operator-----0
 Toll Operator-----211
 Information-----411
 Repair Clerk-----611
 Test Desk----- 51 (not listed)

The above codes, with the exception noted, will be published in the directory. In addition other codes may be introduced such as a code for the installers to use with the test desk. The Chief Operator, Wire Chief, Chief Switchman and other central office employees as require lines in the panel offices will be assigned regular numbers. These regular numbers will not be listed in the directory and dial customers having occasion to talk with any such employees will obtain connection through the "D.S.A." board by dialing "operator".

3. WHO ANSWERS CALLS TO REPAIR CLERK WHEN POSITIONS ARE VACATED?

The Dial System "A" operator.

4. TO WHOM DO CUSTOMERS REPORT STATION TROUBLE?

The same as in manual practice, to the Repair Clerk.

5. WHAT TROUBLES ARE REPORTED BY THE DIAL SYSTEM "A" OPERATOR TO THE REPAIR CLERK?

Line and station trouble discovered by the Dial System "A" operator mainly permanent signals and dial troubles.

6. WHAT SIGNAL IS USED TO INDICATE A CALL INDICATOR CALL BEING HELD UP DUE TO A CALL INDICATOR OPERATOR FAILING TO DISPLAY THE NUMBER?

When a call indicator operator fails to display a number waiting on a call indicator trunk the time measure switch in the sender awaiting the display advances and after a predetermined period the Sender Monitor lamp indicates a stuck sender condition.

7. HOW IS A PERMANENT SIGNAL HOLDING TRUNK HELD BUSY BEFORE THE DIAL SYSTEM "A" OPERATOR ANSWERS?

A line having a permanent signal is automatically routed to a permanent signal holding trunk, and selection follows in the same manner as to "Operator", the district being advanced to position No.13 (Await Operator) in which position the trunk is held busy by ground through the sleeve of the district multiple brush. When the D.S. "A" operator answers the permanent signal holding trunk the district selector advances to the Talking-to Operator position, the operation of the "MB" relay in the permanent signal holding trunk then holds the trunk busy.

8. HOW DOES A REPAIRMAN AT ONE DIAL OFFICE TELEPHONE, CALL THE TEST DESK AT ANOTHER DIAL OFFICE?

A non-listed telephone number is assigned to a line terminating in the test desk. The repairman dials this telephone number in the regular way.

APPARATUS

1. WHAT IS MEANT BY A BRIDGING BRUSH AND WHEN IS IT USED?

A brush which, when passing from one terminal to the next, makes contact with the terminal ahead before breaking contact with terminal it is leaving. It is used in a similar way as the make before break springs of a relay, establishing a new circuit condition before the existing one is opened. It is used on district, office and incoming selectors.

2. WHAT IS THE SPEED OF A ROTARY SELECTOR SWITCH?

The speed depends to some extent on the adjustment. It will operate satisfactorily at approximately 60 terminals per second.

3. WHAT ARE THE SPEEDS OF A PANEL SELECTOR DRIVEN AT HIGH SPEED AND AT LOW SPEED?

Approximately 60 terminals per second at high speed and 15 terminals per second at low speed.

4. WHAT ARE THE APPROXIMATE SPEEDS OF THE VARIOUS ROTATING SHAFTS IN A PANEL DIAL OFFICE.

Drive motors all frames	1765 R.P.M.
Sequence switch drive shaft	36 R.P.M.
Line finder drive rolls	57 R.P.M.
Selector drive rolls, high speed up	
drive and down drive	64 R.P.M.
Low speed up drive	16 R.P.M.

The exact limitations in speeds will be given in speed sheets by the manufacturer at the time of installation.

5. WILL AN OUTSIDE POWER FAILURE CAUSE A COMPLETE FAILURE OF THE LOCAL SYSTEM?

No. As a general rule, offices in the larger cities are supplied with two separate sources of power. A case of failure from one source will automatically transfer the Exchange operation on to the 48 volt D.C. battery source without interruption of service. In the meantime, steps would be taken to operate the office from the reserve power source. Sufficient reserve is also provided in the batteries to carry the exchange load plus the drive motor load for a reasonable period of time at the busy hour rate of discharge during which period it is anticipated that one or both of the outside power sources will be restored for service.

When considered justified due to special conditions, an auxiliary "house plant" or reserve equipment is provided, with the proper facilities for carrying the exchange load until the line is restored. The house plant is an entirely separate power plant, local to the exchange building consisting of generators which will provide power of the same characteristics as the line service, directly connected to engines operated from gas or gasoline.

6. WHAT IS THE SOURCE OF ENERGY FOR THE VARIOUS DRIVES?

Small fractional horsepower duplex motors are used for driving the vertical shafts which in turn rotate the sequence switches. Small fractional horsepower motors are also used to drive the friction rolls which furnish the power for the up and down drive for the selectors on the various types of mechanical frames. These motors are arranged to operate normally on 60 cycle A.C. and in the case of failure of the A.C. source will operate on 48 volt D.C. from the exchange batteries. In all cases the drive motors are first started on D.C. and then transferred to A.C. for normal operation. The brushes of the D.C. motor are normally held away from the commutator by means of springs, but are pulled down on the commutator by means of a brush closing magnet which is energized when the A.C. relay releases due to the failure of the outside source. On restoration of the outside A.C. source the A.C. relay is again operated, which opens the D.C. shunt field and breaks the current through the brush closing magnet, permitting the springs to pull the brushes away from the D.C. commutator. The transition from A.C. to D.C. operation and the reverse transition back to the A.C. operation is accomplished without an appreciable variation in motor speed. Notice of failure of the outside source is given to the maintenance men by means of a lamp and bell located on a floor alarm board, these being operated by a third lead from the motor.

7. WHY ARE THE DRIVING AND DRIVEN DISCS OF THE SEQUENCE SWITCH RUSTED?

The sequence switch is driven by friction when the driven disc is caused to make contact with the driving disc and the rusting of these discs provides sufficient friction to prevent slipping.

8. WHY DOES THE DRIVEN DISC OF THE SEQUENCE SWITCH HAVE ONE SIDE KNURLED?

It is a manufacturing detail performed to level the disc and stiffen the metal.

9. WHY ARE SOME SEQUENCE SWITCH POSITIONS SHOWN CLOSED ONE OR MORE POINTS AHEAD OF WHEN THEY ARE ACTUALLY NEEDED?

In order to use standard cam cuttings.

10. WHY IS THE "A" CAM OF THE SEQUENCE SWITCH TERMED THE CENTERING CAM?

The cam is fluted and a roller on the end of a contact spring rides the fluted surface and causes a contact to be made with the sequence switch drive magnet at points other than the center, in which case the roller is at its lowest point and the contact is open.

11. WHY ARE TWO SPEEDS NECESSARY ON THE FINAL FRAME?

In making the units selection the time interval for brushes to pass between adjacent sets of terminals would be too short at the high speed to permit accurate control by the sender, therefore, a low speed drive is provided.

12. DO MULTIPLE BRUSHES DIFFER ON THE VARIOUS TYPES OF SELECTORS?

Yes. The multiple brushes for the district, office and incoming selectors are the same and are of the trunk hunting type with four contact springs, the outer two of which make with the tip and ring terminals and the two inner make with the sleeve terminal. The final selector brush is not a trunk hunting brush. Only one of the inner springs is used in the circuit. The other spring is given the same adjustment and makes contact with the sleeve terminal only to balance the brush. The line finder brush differs in that the two inner springs are offset more than those of the other types and each inner spring makes contact with separate terminals, i.e., the sleeve terminal and the hunting terminal. The trip fingers of the line finder brush differ from those of the other types on account of the different tripping arrangement.



